

N. O.; Andersonville, S. C.; University of Virginia, Va. 13th, Quakertown, Pa. 14th, Vashon, Wash. 15th, Marquette, Nebr. 17th and 18th, Fort Sully, Dak. 19th, Nashua, N. H. 21st, Boise City, Idaho; Nashua, N. H.; Clayton, N. J. 23d, Fort Stanton, N. Mex.; Vashon, Wash. 24th, Andersonville, S. O.; Cairo, Ill. 25th, Dover, N. J.; Vashon, Wash., 26th, Yaquina L. H., Oregon. 27th, Dover, N. J. 28th, Beverly, N. J.

MIGRATION OF BIRDS.

Geese flying southward.—Linkville, Oregon, 2d, 3d; Red Bluff, Cal, 2d, 5th, 29th; Boston, Mass., 9th; Omaha, Nebr., 11th; Fort Madison, Iowa, 13th, 16th; Fort Sill, Ind. T., 14th; Fort Smith, Ark., and Keokuk, Iowa, 19th; De Soto, Nebr., 27th.

Geese flying westward.—San Antonio, Tex., 10th.

Swans flying eastward.—Nicolaus, Cal., 25th.

Ducks flying southward.—Corpus Christi, 20th; Savannah, Ga., 28th.

MIRAGE.

Fort Maginnis, Mont.: at 1.30 p. m. on the 6th buttes, woods, and basins situated about sixty miles southwest of station were

plainly seen and recognized; the Yellowstone River, about fifty miles distant, was clearly defined, and its course could be traced for miles; this mirage was considered the most unusual that has been seen here for years.

Mirages were also observed at Saint Vincent, Minn., on the 11th, and at Marquette, Nebr., on the 6th, 9th, 10th, 21st.

PRAIRIE FIRES.

Fort Sill, Ind. T.: prairie fires were observed to the north and east of station on the 3d.

SAND STORMS.

Yuma, Ariz.: a violent sand storm began about noon on the 13th and continued until the following day; a maximum wind-velocity of forty miles per hour was recorded at 10.30 p. m.

Sand storms also occurred as follows: Yuma, Ariz., 2d, 11th, 29th; Fort Mojave, Ariz., 12th, 13th, 21st, 28th; Fort Grant, Ariz., 21st.

SUN SPOTS.

Mr. H. D. Gowey, North Lewisburg, Champaign Co., Ohio, observed sun spots as follows: 5th, 6th, 13th, 14th, 16th, 21st, 23d, 25th, 26th.

VERIFICATIONS.

INDICATIONS FOR 33 HOURS IN ADVANCE.

The percentages of verifications of the tri-daily indications for December, 1887, as determined from comparison of succeeding telegraphic reports are given in the table below:

The predictions for all districts east of the Rocky Mountains for December, 1887, were made by 1st Lieutenant Robert Craig, 4th Artillery, U. S. Army, Acting Signal Officer and Assistant, except those for Minnesota and eastern Dakota, which were made at Saint Paul, Minn., by 1st Lieutenant Thomas M. Woodruff, 5th Infantry, U. S. Army, Acting Signal Officer, and those for the Pacific coast districts were made at San Francisco, Cal., by 2d Lieutenant J. E. Maxfield, Signal Corps; the verifications for all districts were determined by Junior Prof. H. A. Hazen.

Percentages of indications verified, December, 1887.

States.		States.	
Maine.....	76.35	Kentucky.....	81.87
New Hampshire.....	74.30	Ohio.....	76.32
Vermont.....	72.45	West Virginia.....	75.97
Massachusetts.....	76.28	Indiana.....	76.90
Rhode Island.....	77.02	Illinois.....	79.71
Connecticut.....	78.42	Lower Michigan.....	78.11
Eastern New York.....	71.35	Upper Michigan.....	78.81
Western New York.....	73.45	Wisconsin.....	77.71
Eastern Pennsylvania.....	73.97	Minnesota.....	75.40
Western Pennsylvania.....	77.10	Iowa.....	80.45
New Jersey.....	73.52	Kansas.....	77.45
Delaware.....	74.45	Nebraska.....	73.12
Maryland.....	69.48	Missouri.....	74.68
District of Columbia.....	78.03	Colorado.....	75.32
Virginia.....	74.13	Eastern Dakota.....	70.45
North Carolina.....	77.29	Southern California.....	86.65
South Carolina.....	73.13	Northern California.....	74.55
Georgia.....	74.10	Oregon.....	70.57
Eastern Florida.....	70.83	Washington Territory.....	73.37
Western Florida.....	71.71	By elements:	
Alabama.....	77.77	Weather.....	75.46
Mississippi.....	77.16	Wind.....	79.25
Louisiana.....	70.39	Temperature.....	74.11
Eastern Texas.....	69.81		
Arkansas.....	72.81	General average.....	75.30
Tennessee.....	78.19		

* In determining the general average percentage and the percentages for the different elements, Minnesota, eastern Dakota, and Pacific coast states have not been included.

CAUTIONARY SIGNALS.

Of the total number of cautionary and storm signals ordered during December, 1887, it was practicable to determine the justification or failure of sixty-nine; justified, forty-nine, or 71.02 per cent. Of the above, thirty-five were ordered for cautionary signals; number justified, twenty-six, or 74.29 per cent. Thirty-four storm signals were ordered; justified, twenty-three,

or 67.65 per cent. Total number of direction signals ordered, eighty-three; justified, seventy-eight, or 93.98 per cent. Number of signals ordered for easterly winds, forty; justified, thirty-six, or 90.00 per cent. Number of signals ordered for westerly winds, forty-three; justified, forty-two, or 97.67 per cent. Number of storms without signals, eight. Number of signals ordered late, i. e., after the justifying velocity had begun, seven, or 10.14 per cent.

COLD-WAVE SIGNALS.

Total number of cold-wave signals ordered, three hundred and sixteen; justified, two hundred and forty-seven, or 78.16 per cent. Sixty-three cold-wave signals were ordered during the month by the Signal Service Officer at Saint Paul, Minn., of which, fifty-three, or 84.13 per cent., were justified.

LOCAL VERIFICATIONS.

The following is from the report of the "Michigan State Weather Service" for December, 1887:

Weather and temperature signals are now displayed in one hundred and forty-two towns in the state, and on the baggage-cars of twenty-six trains on eight principal railroads of the state.

The percentage of verification of weather signals for December is as follows (the verification is taken from reports of displaymen furnished this office monthly): temperature, 81.6 per cent.; weather, 83.9 per cent.; temperature and weather, 82.8 per cent.

The percentage of verification of weather predictions for December on the D., G. H., and M. R'y., is 85.0 for weather and 76.7 for temperature; on the C. & G. T. R'y., weather, 83.8, and temperature, 79.2; P. H. & N. W. R'y., weather, 82.0, and temperature, 83.2; M. C. R'y., for weather, 85.9, and for temperature, 92.8; G. R. & I. R'y., weather, 83.0, and temperature, 81.3; C. & W. M. R'y., weather, 85.8, and temperature, 84.7; P. O. & P. A. R'y., weather, 79.7, and temperature, 83.7.

Cold-wave signals were ordered by the Chief Signal Officer on the 4th at 11 a. m.; 10th, at 7 a. m., and continued until the 12th; on the 19th and continued until 7 a. m. 22d, and on the 27th and continued until 7 a. m. of the 29th. The signal of the 4th was verified by a fall of 30°; that of the 10th by 15°. The order of the 19th was not justified until the morning of the 22d, when a fall of 85° was recorded; a fall of 25° followed the order of the 27th.

The following is from the December, 1887, report of the "South Carolina Weather Service:—"

The percentage of verification of the weather and temperature predictions for the whole state was: for weather, 86.4; for temperature, 91.9.

The following is from the "Tennessee State Board of Health Bulletin" for December, 1887:

There were four cold-wave warnings received during the month, viz.: 4th-5th, 11th-18th, 19th-22d, and 27th-29th; all fully verified.

The percentage of verification of weather and temperature predictions, fur-

nished daily from the Signal Office at Washington to the various stations in the state during the month, was for the state: weather, 84.4 per cent.; and temperature, 85.6 per cent.

The following is from the report of the "Nebraska Weather Service:—"

The daily predictions of the Chief Signal Officer have been distributed by this service to upwards of fifty stations, partly by mail and partly by telegraph, and arrangements are being made to increase the list of such stations. The value of this service is evinced by the increasing number of places desiring the predictions. The percentage of correct predictions for December is 87; 86 for weather, and 88 for temperature.

STATE WEATHER SERVICES.

The following extracts are republished from reports for December, 1887, of the directors of the various state weather services:

The "Alabama Weather Service," P. H. Mell, jr., of the Agricultural and Mechanical College, Auburn, director:

Very few days in the month were clear and pleasant. The period was generally cloudy, with frequent occurrence of rains, making December the wettest month of the year. The excess of precipitation over the normal was 4.99 inches. This unusual rainfall was rendered necessary to fill up the deficiencies in the first and second quarters of the year. Even with this heavy fall, however, the annual precipitation is below the average 10.53 inches. The temperature was 3° below the normal. There were four cold waves predicted for the month, viz., on the 5th, 19th, 21st, and 28th. The one predicted for the 19th failed to make its appearance. The others came as indicated, and although the reduction of temperature was unpleasant, still the waves were not severe for the season of the year.

Summary.

Atmospheric pressure (in inches).—Monthly mean, 30.15; maximum observed, 30.74, at Auburn, on the 1st; minimum observed, 29.48, at Montgomery, on the 24th; range for state, 1.26.

Temperature (in degrees Fahr.).—Monthly mean, 45° 9'; highest monthly mean, 58° 6', at Newton; lowest monthly mean, 38° 6', at Chattanooga; maximum, 73°, at Greenville, on 6th; minimum, 10°, at Gadsden, on the 29th; range for state, 63°; greatest local monthly range, 51°, at Greenville; least local monthly range, 38°, at Newton.

Precipitation, including melted snow (in inches).—Average for the state, 9.84; greatest, 15.95, at Mount Willing; least, 5.46, at Chattanooga, Tenn.

Winds.—Prevailing direction, southeast.

The "Monthly Review of the Illinois Weather Service," Col. Charles F. Mills, Springfield, director:

The general meteorological features of the month were not very unusual. The changes in pressure, with two exceptions, were not great, but were quite numerous. The daily isobars, or lines of equal pressure, were very irregular, and only few symmetrical "highs" or "lows" were formed. The "highs" of the 21st, 22d, 28th, and 29th, and the "low" of the 31st were the most notable; especially the last two which were each the extreme of its class during the month. From the 29th, when the barometer at Springfield was 30.76, to the 31st, when it was 29.44, the fall was 1.32 inches, a very unusual one in such a brief period of time. The month opened with a very high barometer and ended with a very low one.

The mean temperature of the month for the state was 1° above the mean of ten years, the excess being greater in the northern division, where it was 1° 9', and least in the southern, where it was only 0° 4'.

The precipitation for the month was also above the average of ten years, 1.08 inches for the state, 1.63 inches for the northern, and 0.04 of an inch for the southern division.

The "Indiana Weather Service," Prof. H. A. Huston, of Purdue University, Lafayette, director:

The barometric pressure during the month was slightly below the normal for the state, and subject to rapid and great oscillations, especially so on the 3d, 11th, 17th, 20th, 27th, and 30th. Exceedingly high readings were noted on the 1st and 30th, while the lowest occurred on the 31st.

The temperature was nearly normal; a uniformly cool temperature prevailed, only interrupted by a warm period on the 3d and 4th; the lowest temperatures prevailed on the 22d, 29th, and 30th; the temperatures during the latter dates reached below zero.

The precipitation was slightly in excess; heavy rains occurred on the 3d and 4th, and quite a heavy and steady rainfall on the 31st was preceded during the afternoon and evening of the 30th by heavy snows at many stations.

Summary.

Atmospheric pressure (in inches).—Monthly mean, 30.138; maximum observed, 30.800, at Lafayette, on the 29th; minimum, 29.520, at Worthington, on the 31st; range for state, 1.280; greatest local range, 1.264, at Mount Vernon; least local range, 1.050, at Vevay.

Temperature (in degrees Fahr.).—Monthly mean, 30.3; highest monthly mean, 36.1, at Marengo; lowest monthly mean, 26.8, at La Grange; maximum, 60.0, at Rockville, on the 4th; minimum, -9.0, at Lafayette, on the 29th; range for state, 57.1; greatest local monthly range, 64.0, at Richmond, Lafayette, and Logansport; least local monthly range, 49.0, at Fort Wayne.

Precipitation, including melted snow (in inches).—Average for the state, 3.76; greatest, 7.23, at Marengo; least, 2.30, at Crawfordsville.

Wind.—Prevailing direction, southwest.

The "Louisiana State Weather Service," in charge of R. E. Kerkam, Sergeant, Signal Corps, at New Orleans:

The mean temperature of the month for the state, 49° 6', was 1° 9' below the December normal for the past seventeen years, in which period the lowest December mean, 42° 6', occurred in 1876, and the highest, 57° 9', in 1875. There were but few Decembers in the above-named period in which the mean temperature was below that of the past month. The mean temperature of the northern section was 46° 8', and of the southern section, 51° 8'. The maximum temperature, 77°, was reported from Donaldsonville and New Iberia on the 4th, and from New Orleans on the 7th. The minimum temperature, 20°, was reported from Shreveport, on the 21st. The mean daily range of temperature for the state was 13.9. The greatest daily range, 32°, was reported from Delta on the 6th, and the least daily range, 2°, from Monroe on the 16th.

The average precipitation for the state for the past month, 7.34 inches, was 2.04 inches above the December average of the past seventeen years, in which period it was exceeded but twice—1872, 7.56 inches, and 1884, 18.31 inches. The average for the northern section, 7.16 inches, was 1.54 inches above, and for the southern section, 7.51 inches, was 2.45 inches above the December normal. The average number of days on which measurable precipitation fell was fourteen, consequently the distribution was regular throughout the month, the heaviest general rains occurring on the 23d-24th.

The prevailing direction of the wind was from the north in the northern section, and from the northeast in the southern section. The average total movement of wind for the state was 5,354 miles, making an average hourly velocity of 7.2 miles. The highest velocities occurred on the 31st at all the stations reporting—the maximum reported being 36 miles per hour, from the west, at Vicksburg.

A mean relative humidity of 88 per cent. for the month is deduced. This is over 11 per cent. above the December normal.

Summary.

Temperature (in degrees Fahrenheit).—Monthly mean, 49.6; highest monthly mean, 52.9, at New Orleans; lowest monthly mean, 45.4, at Shreveport; maximum, 77, at Donaldsonville and New Iberia on the 4th, and at New Orleans, on the 7th; minimum, 20, at Shreveport, on the 21st; range for state, 57; greatest local monthly range, 54, at Shreveport; least local monthly range, 40.4, at Grand Coteau; greatest daily range, 32, at Delta, on the 6th; least daily range, 2, at Monroe, on the 16th.

Precipitation, including melted snow, (in inches).—Average for the state, 7.34; greatest, 8.26, at New Iberia; least, 6.56, at Liberty Hill.

Wind.—Prevailing direction, northeast.

The "Michigan Weather Service," N. B. Conger, Sergeant, Signal Corps, Lansing, director:

The meteorological features of the state are based upon reports received from seventy-eight voluntary, and eight United States Signal Service observers.

Atmospheric pressure (in inches and hundredths).—The mean monthly pressure is 30.06. The mean pressure for each section is, this month, nearly the same, the greatest difference occurring in the southern section. The area of high pressure, which was central over Michigan on the a. m. of the 1st passed rapidly eastward, and was followed by a low area which was central over the state on the evening of the 3d, moving eastward. This low area was accompanied by heavy rain throughout the state during the afternoon and evening of the 3d and changed to snow on the 4th. The low area of the 17th first appeared on the a. m. of the 16th in Montana and Northwest Territory and moved eastward, and was central over northern Michigan and Lake Superior on the morning of the 17th, and during the day the pressure slowly decreased, and rose steadily until the 22d. A low area appeared on the 31st which developed rapidly, and was accompanied by snow, turning to rain, on the evening of the 31st. A high area passed on the 24th and 28th, accompanied by decidedly cold weather.

Temperature (in degrees Fahr.).—The mean monthly temperature, 27.4, is 1.0 above the normal of thirteen years. The upper peninsula is 0.2 below the normal; the northern section 1.6 above the normal; the central section 1.0, and the southern section 0.4 above the normal. The highest temperature for the month, 66, was recorded at Coldwater, in the southern section, on the 4th, and the lowest temperature, -18.5, at Mottville, in the southern, on the 30th. The mean range of temperature is 50.7. The highest mean daily temperature, 50.0, was recorded at Sand Beach on the 4th, and the lowest mean daily temperature, 8° 0', was recorded at Calumet on the 28th. The warmest day was the 4th, when the mean temperature for the state was 40.0, and the coldest days were the 29th and 30th, the mean temperature being 12.0. Comparing this with the mean daily temperatures for December since 1875, it is